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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/589,399	08/14/2006	Guo-Quan Lu	124617.00118	7126

27557 7590 02/18/2009

BLANK ROME LLP
WATERGATE
600 NEW HAMPSHIRE AVENUE, N.W.
WASHINGTON, DC 20037

EXAMINER	
TAKEUCHI, YOSHITOSHI	
ART UNIT	PAPER NUMBER
1793	

MAIL DATE	DELIVERY MODE
02/18/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/589,399	LU ET AL.	
	Examiner	Art Unit	
	YOSHITOSHI TAKEUCHI	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 August 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11-28-2006 & 10-30-2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims **1-6** are rejected under 35 U.S.C. 102(b) as being anticipated by Kydd (US 5,882,722).

a. Regarding claims **1-6**, Kydd teaches a colloidal silver suspension with particles with a diameter of about 10 to 40 nanometers (abstract); dispersants, such as stearic acid, associated with the metal powder to prevent agglomeration of the metal powders (column 8, lines 64-66, where stearic acid is a fatty acid), where the dispersant is present in sufficient quantity to reduce agglomeration of said particles (implied, since the dispersant is added to disperse particles); and binders, such as ethyl cellulose in the composition (column 5, line 34, where ethyl cellulose), having a volatilization temperature below the metal powder's sintering temperature.

b. The preamble "for forming electrical interconnect" in claim 1 is treated as intended use, therefore is not given patentable weight. MPEP § 2111.02(II).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 7-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et a1 (US 6,114,413) in view of Kydd (US 5,882,722).

a. Regarding claim **7**, Kang teaches a method of forming a conductive paste used to form a mechanical and thermal metal interconnect layer between the contacts device and a substrate (column 6, lines 50-57) by sintering metal particles together (column 2, lines 64-65) and forming a metal layer from said metal particles. Kang teaches the particle size

can be adjusted depending on the application (column 4, lines 1-3), but does not teach the metal in the particle size of less than 500 nm.

Kydd teaches a colloidal silver suspension, with particles with a diameter of about 10 to 40 nanometers, used to form solid interconnections for printed circuit boards and packaging of electronic components (abstract).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use the method of Kang to manufacture the silver colloid suspension of Kydd since the compositions are similar and have the same use (i.e. bonding layer between a device and substrate), Kang teaches the particle size can be adjusted for the application, and the finer particles sizes of Kydd permit formation of a thinner film from using the process of Kang.

b. Regarding claim **8**, Kang in view of Kydd teaches the method of claim 7, and Kang teaches depositing an electrical contact between the device and the substrate (column 6, lines 60-65).

c. Regarding claim **9**, Kang in view of Kydd teaches the method of claim 8, and Kydd teaches silk screening, printing, and stenciling (abstract). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to deposit the paste in the Kang method by the means of screening, printing or stenciling taught by Kydd, since the compositions are similar and have the same use (i.e. bonding layer between a device and substrate).

d. Regarding claims **10** and **12**, Kang in view of Kydd teaches the method of claim 7, where Kang teaches the use of "[a]ny powder material with a high thermal

conductivity" (column 4, lines 32-33), with a particle size that can be adjusted for the application (column 4, lines 1-3) and Kydd teaches a colloidal silver suspension with particles with a diameter of about 10 to 40 nanometers (abstract).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use the method of Kang to manufacture the silver colloid suspension of Kydd since the compositions are similar and have the same use (i.e. bonding layer between a device and substrate), Kang teaches the particle size can be adjusted for the application, and the finer particles sizes of Kydd permit formation of a thinner film from using the process of Kang.

e. Regarding claim **11**, Kang in view of Kydd teaches the method of claim 7, and Kang teaches holding the device and the substrate together during sintering (claim 20).

f. Regarding claim **13**, Kang in view of Kydd teaches the method of claim 7, where Kang teaches the metal prior to sintering is present in the form of a paste (abstract) with sufficient dispersant to reduce agglomeration of the metal particles (column 4, line 66 to line 5, line 2, where the "sufficient" limitation is impliedly met since the dispersant is added to disperse particles), but does not expressly teach the binder having a volatilization temperature below the sintering temperature of said metal.

Kydd suggests a binder having a volatilization temperature below the sintering temperature of said metal particles (column 6, lines 61-67, where the liquid portion of the mixture at decomposes at 200°C and the powder sinters at 300°C).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use a binder with a volatilization temperature below the sintering

temperature of the powders, as taught in Kydd, in the method of Kang, since volatilization of the binder permits the powder to sinter to near theoretical density, an important mechanical and thermal characteristic for the use taught by both patents (i.e. bonding a semiconductor device to a substrate).

g. Regarding claim **14-16**, Kang teaches a method for connecting a substrate and a device, comprising: positioning a paste between contacts of a substrate and a device (column 6, lines 60-64) where the paste is comprised of a plurality of metal particles, a dispersant associated with particles of the metal powder present in sufficient quantity to reduce agglomeration of said particles of the metal powder (column 4, line 66 to line 5, line 2, where the "sufficient quantity" limitation is implied since the dispersant is added to disperse the particles), and where the resulting sintered layer mechanically and thermally interconnects the device and the substrate (column 6, lines 50-57). Kang does not teach particles with a size of 500 nm or less; a binder with a volatilization temperature below the sintering temperature of the metal powder; heating the paste to a temperature and for a time sufficient to remove the binder and dispersant, and to sinter the metal powder to form a metal layer.

Kydd teaches a colloidal silver suspension with particles having a diameter of about 10 to 40 nanometers (abstract). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use the silver nanoparticles of Kydd in the process of Kang since the compositions are similar and have the same use (i.e. bonding layer between a device and substrate), Kang teaches the particle size can be adjusted for

the application, and the finer particles sizes of Kydd permit formation of a thinner film from using the process of Kang.

Kydd suggests a binder having a temperature of volatilization below the sintering temperature of said metal particles (column 6, lines 61-67, where the liquid portion of the mixture at decomposes at 200°C and the powder sinters at 300°C). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use a binder with a volatilization temperature below the sintering temperature of the powders, as taught in Kydd, in the method of Kang, since volatilization of the binder permits the powder to sinter to near theoretical density, an important mechanical and thermal characteristic for the use taught by both patents (i.e. bonding a semiconductor device to a substrate).

It was well known in the art at the time of the invention that binder material trapped in voids during sintering reduce the theoretical density of the sintered material, and heating the paste to a temperature and for a sufficient time to remove the binder before sintering is useful for clearing binder from voids. Kydd suggests that sintering to theoretical density is favorable for improved electrical resistance and mechanical strength properties (column 6, line 65 to column 7, line 1).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to heat the paste for at an adequate temperature and time to remove the binder in the process of Kang as modified by Kydd, since Kydd teaches that a sintered paste with near-theoretical density has favorable characteristics, and it is well known in the art at the time of the invention to remove a binder prior to sintering.

h. Regarding claim **17**, Kang in view of Kydd teaches the method of claim 14, where Kydd teaches silk screening, printing, and stenciling (abstract).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to deposit the paste of Kydd by screening, printing or stenciling, as taught by Kydd, as means of depositing the composition of Kang since the compositions are similar and have the same use (i.e. bonding layer between a device and substrate).

i. Regarding claim **18**, Kang in view of Kydd teaches the method of claim 14, but does not expressly teach the step of selecting a binder in a paste based on a desired temperature of volatilization of the binder. However, it was well known in the art at the time of the invention that binder material trapped in voids during sintering reduce the theoretical density of the sintered material, and selecting binders with a volatilization temperature below the sintering temperature is useful for clearing binder from voids. Kydd suggests that sintering to theoretical density is favorable for improved electrical resistance and mechanical strength properties (column 6, line 65 to column 7, line 1).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to select a binder in the process of Kang based on a desired temperature of volatilization of the binder, since Kydd teaches that a sintered paste with near-theoretical density has favorable characteristics, and it is well known in the art at the time of the invention to choose a binder with a volatilization temperature below the sintering temperature.

j. Regarding claims **19** and **20**, Kang in view of Kydd teaches the method of claim 14, and Kydd teaches isolating the metal particles with the binder until a preset

temperature during the heating step, wherein said preset temperature is 270°C, the same as or slightly below 300°C, the sintering temperature for the silver particles (column 6, lines 64-67 and column 7, lines 6-7).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to have the additional step, as taught by Kydd, to isolate the metal and binder until a preset temperature slightly below the silver particles' sintering temperature.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to YOSHITOSHI TAKEUCHI whose telephone number is (571) 270-5828. The examiner can normally be reached on Monday-Thursday 9:30-3:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dr. Roy King can be reached on (571) 272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Roy King/

Supervisory Patent Examiner, Art Unit 1793

/YOSHITOSHI TAKEUCHI/
E0xaminer, Art Unit 1793